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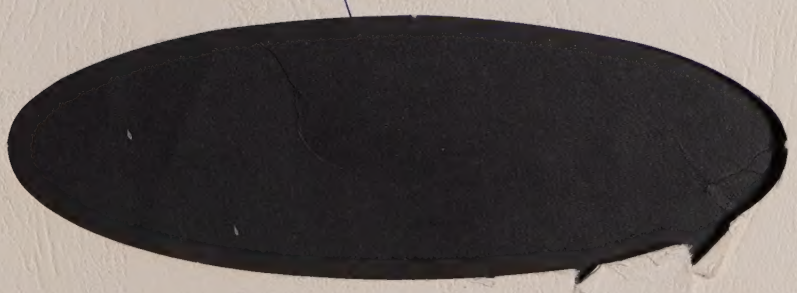
INSTRUMENT CONTROL
SYLVANIA SES -- West

EXACT

ELECTRONICS, INC.



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SYLVANIA SES -- West
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The 500 series instruction manual is not complete at this time. For your use now and to assure you that it is nearly ready, we are sending this interim manual.

Please return the card which is bound inside the front cover, properly filled out with delivery station, etc., so that we may send completed manuals as soon as they are ready.

interim

500 series instruction manual

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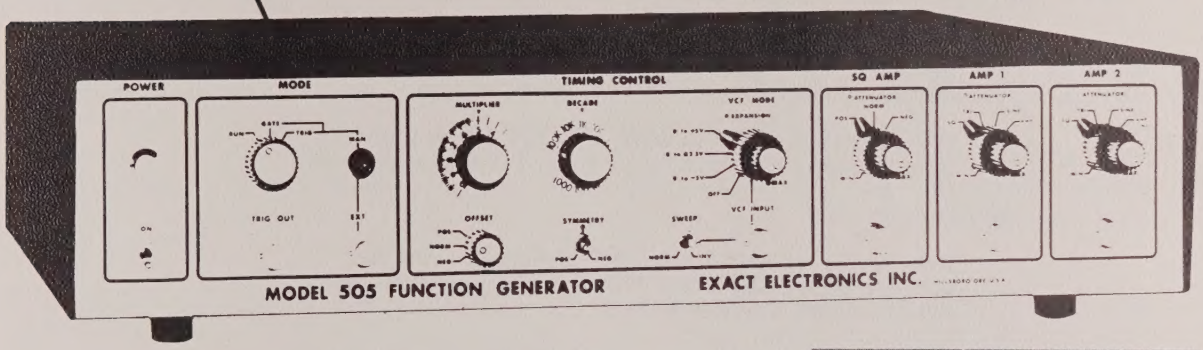
EXACT electronics, inc.

Function Generators • Waveform Synthesizers

MODELS 503, 504 and 505 FUNCTION GENERATORS

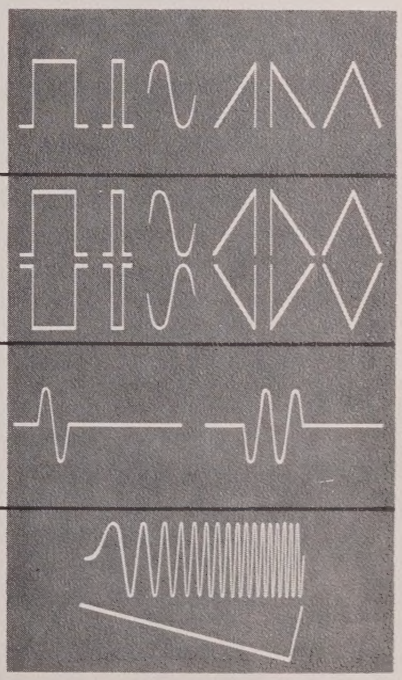


503, 504 and 505 — **Take these signals:**

503, 504 and 505 — **push-pull them:**

504 and 505 — **single-shot or gate them:**

503 and 505 — **add VCF at 50:1**



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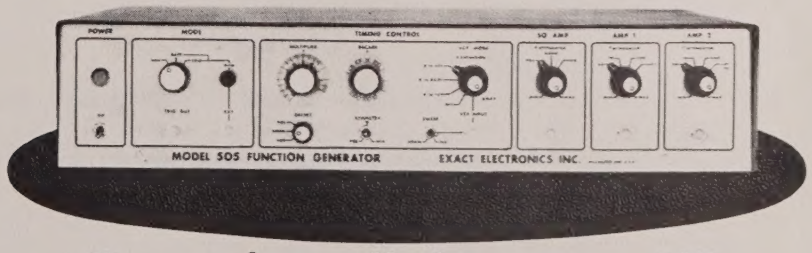


Prices and specifications subject to change without notice.

You can have all this in our 505

EXACT ELECTRONICS INC.
455 S E 2nd Avenue. Hillsboro, Oregon 97123 • TEL: (503) 648-6661

503, 504 AND 505:

OUTPUTS: Three selectable, continuously variable

SQ. AMP

Square: 25V P-P into 600 ohms, 50nsec risetime
Positive square: 0 to 13V P, 50nsec risetime
Negative square: 0 to −13V P, 50nsec risetime

AMP 1

Triangle: 25V P-P into 600 ohms
Sine: 25V P-P into 600 ohms
Ramp: 25V P-P into 600 ohms
Square: 25V P-P into 600 ohms, 50nsec risetime

Positive triangle, square or ramp: 0 to 13V P into 600 ohms
Negative triangle, square or ramp: 0 to −13V P into 600 ohms

AMP 2

Same outputs as AMP 1 with 180° phase shift. Also has provision to put AMP 1 and AMP 2 in phase. Square wave risetime out of AMP 2 is 100nsec.

All three amplifiers are short circuit proof and will drive 50 ohms at reduced amplitudes, approximately 5 volts peak to peak.

FREQUENCY RANGE: .0001Hz to 1MHz in ten decade ranges

FREQUENCY ACCURACY: .0001Hz to 1MHz ±3% of dial reading

FREQUENCY STABILITY: ±0.025% short term (10 min.)
±0.2% long term (24 hr.)

AMPLITUDE STABILITY: ±0.1% short term (10 min.)
±0.25% long term (24 hr.)

DC REFERENCE STABILITY : ±0.05% short term (10 min.)
±0.5% long term (24 hr.)

DC REFERENCE: Amp 1 and Amp 2 0 volts ±50mv
Sq. Amp 0 volts ±75mv

SINE DISTORTION: Less than 1% to 100K, Less than 2% to 1MHz

AMPLITUDE FREQUENCY RESPONSE: ±0.1db .0001Hz to 100KHz
±0.5db 100KHz to 1MHz

TRIANGLE, RAMP LINEARITY: 99% to 10KHz, 98% to 1MHz – Ramp to 100KHz

VCF RANGE (503, 505 only): 50:1

VCF LINEARITY (503, 505 only): 20:1 ±0.1%, 50:1 ±2%

The VCF input will accept three different inputs: 0 to +5V, 0 to −5V, 0 to ±2½V.

504, 505 ONLY:

GATE TRIGGER INPUT: Manual or External, +5V turn ON, approx. +2V turn OFF. Gate D.C. coupled, trigger A.C. coupled.

Trigger Mode requires a pulse of at least 1 usec rise-time to trigger on.

PHYSICAL SIZE: 16¾" wide, 3½" high, 14¾" deep

EXACT ELECTRONICS, INC.
P. O. Box 160, Hillsboro, Oregon 97123
phone (503) 648-6661

MODELS 503, 504, 505 FUNCTION GENERATORS

The following description of the Model 505 applies to the 503 and 504 with the exceptions that the 504 does not contain VCF circuitry and the 503 does not contain gating circuitry.

The 505 function generator is one of the most versatile instruments ever designed in a fixed-package configuration. It features UNITIZED CONSTRUCTION and INTEGRATED circuits. Like the lower cost forerunners (501 and 502) the 505 is designed with built-in reliability. In addition to all the features of the 501 and 502, it has many added.

The 505 has THREE AMPLIFIERS, each with its own selector switch and attenuator. These amplifiers are designed to produce a minimum of 25V P-P into 600 ohms. They are SHORT-CIRCUIT PROOF and will drive 50-ohm loads at reduced amplitudes (approx. 5V P-P).

SQUARE WAVE AMPLIFIER: With the SELECTOR switch in the NORM position, a bi-polar square waveform of approximately 25V P-P into 600 ohms is available. Setting the switch to POS develops a positive-going square wave from ground at approximately +12V P into 600 ohms. In the NEG position a -12V P into 600 ohms is available.

NO. 1 and NO. 2 AMPLIFIERS: These two amplifiers are similar. Each provides selection of one of the following waveforms: (a) square, (b) triangle, (c) sine, or the other amplifier, all with continuous amplitude control from zero to approximately 25V P-P into 600 ohms. The difference between amplifiers is Amp 1 is non-inverting and Amp 2 is an inverting amplifier. The two amplifiers provide push-pull outputs automatically with individual amplitude controls. When Amp 2 is in Amp 1 INV position, you would still have a push-pull output except that amplitudes of both can be controlled by Amp 1, Amp 2 amplitude is used for balance. For example, if Amp 1 were set for SINE and Amp 2 were set to Amp 1 INV., the unit would produce a push-pull output. Amp 1 produces 25V P-P into 600 ohms at zero degrees while Amp 2 produces 25V P-P into 600 ohms at 180 degrees. The attenuator for Amp 2 is now used to match the amplitude of the waveform out of Amp 1. Adjusting the attenuator of Amp 1 will now control the amplitude of both waveforms. This provides a very useful push-pull amplifier with a single output amplitude control.

The FREQUENCY RANGE of the instrument is from 0.0001Hz to 1MHz. When placing the OFFSET switch to NEG or POS several important things happen. First and probably most important, the frequency of the generator is now doubled. In other words, the upper frequency range is now 2MHz. With this switch in the POS or NEG position, Amp 1 and Amp 2 produce triangle waveforms positive or negative going from ground. The square wave will double in frequency but is still symmetrical about ground.

The SINE WAVEFORM under these conditions becomes similar to the output of a full wave rectifier without filtering and is very useful in filter testing.

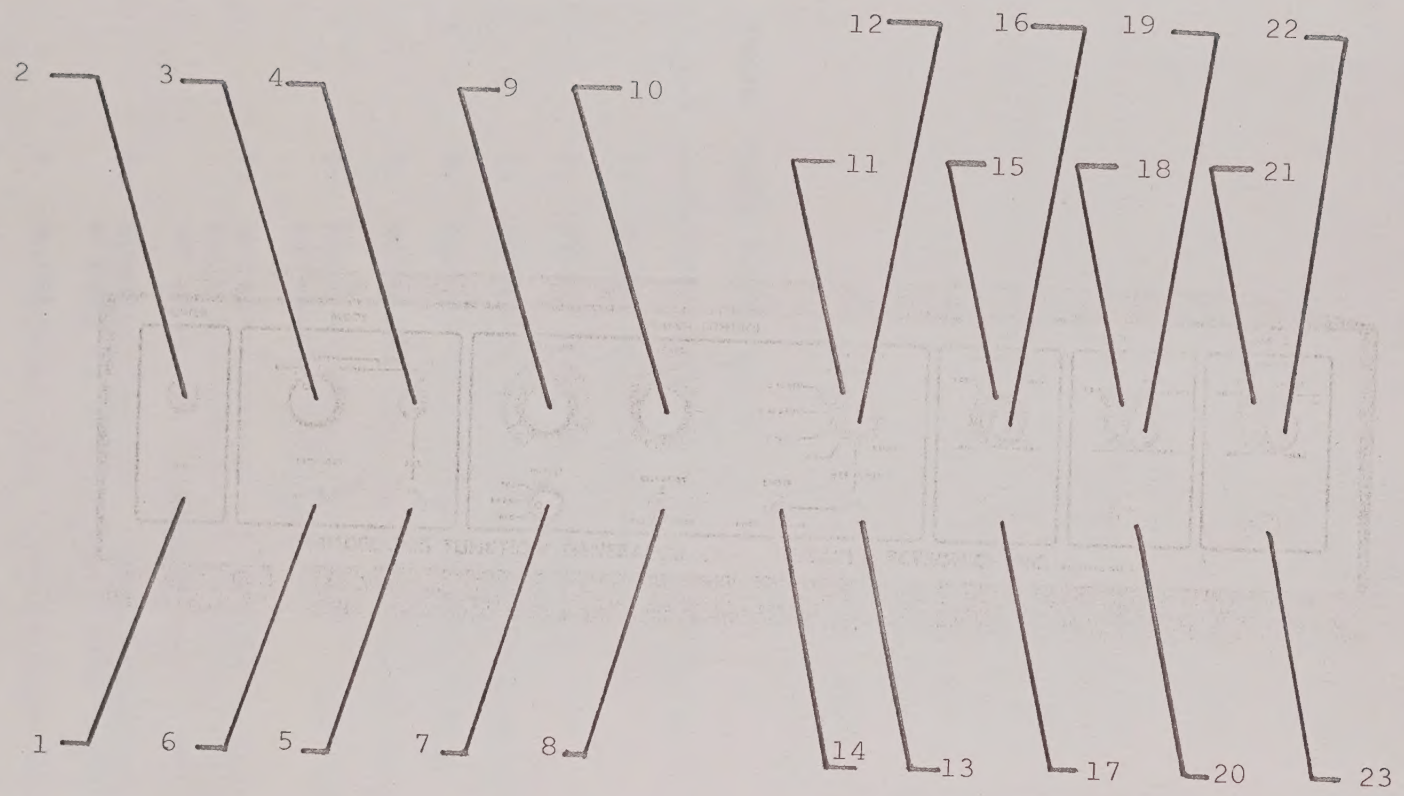
RAMP WAVEFORMS and pulses are available at the amplifiers by placing the SYMMETRY switch to either POS or NEG. Placing the switch to POS will produce a normal ramp. Using the amplifier as a push-pull device will provide push-pull ramp waveforms. Setting the SYMMETRY switch to NEG produces a reverse ramp often referred to as an "N" waveform. The ramp waveforms appear at amplifiers #1 and #2 in the TRI position of the selector switch. The ramp waveforms may start at a negative voltage and rise through zero to a positive voltage out of one amplifier and the reverse out of the other amplifier when the OFFSET switch is in NORM. Placing the OFFSET switch to POS and using the SYMMETRY to produce ramp or "N" waveforms will now produce waveforms at the amplifiers that START AT ZERO VOLTS, rise to a positive voltage and return to zero. These waveforms can be push-pull. Ramp frequency will always be twice dial setting, plus fallti

PULSES ARE AVAILABLE when the SYM switch is in the POS or NEG position at outputs of all amplifiers if the selector switches are set to SQ. The pulse may be bi-polar, negative or positive-going from ground, depending on the setting of the selector switch of the square amp. Pulse width is fixed and equal to ramp falltime.

The VCF portion of the generator is probably the most flexible circuitry ever developed. First of all, the VCF ratio is 50:1 with a very linear voltage vs frequency curve. It can be used out to 100:1 with a degrading of linearity. Linearity will be specified out to the 50:1 ratio and a characteristic curve will allow the user to determine linearity to 100:1.

A selector switch provides a selection of input voltages depending on what the user has available. They are 0 to +5 volts, 0 to -5 volts, and 0 to ±2½ volts. When used in conjunction with the SWEEP switch, the user has a choice of sweeps; he may sweep up in frequency or down in frequency. For example, let's assume he has a 0 to +5V ramp as a sweep source. If he switches the VCF mode switch to 0 to +5V, he would sweep down in frequency with the SWEEP switch set to NORM. Setting the SWEEP switch to INV would reverse this and cause the unit to be swept upward in frequency to the dial setting. In the INV position the generator drops to approximately 50:1 with 0 volts input. When VCF mode switch is set to ±2½V with zero volts VCF input, the generator frequency will drop to approximately one-half of dial setting, expansion control set to CAL. With sweep switch set to NORM and a ramp input starting at -2½V, the generator will drop in frequency from the center frequency to the low end of the sweeping range, 1/50 of dial setting. As the ramp goes positive, the generator frequency will increase at a linear rate until the input reaches the +2½V peak at which time the generator will be at the dial setting. When the sweep switch is set to NORM the reverse will happen. In other words, the generator will sweep from the dial frequency down to the low end of the sweep range, 1/50 of dial setting. The ratio of sweep vs voltage or expansion is adjusted by using the EXPANSION control (VCF not applicable to Model 504).

GATING AND TRIGGERING are standard on the 504 and 505. An external gate pulse will produce a number of waveforms. The unit may also be manually gated. It may be internally or externally triggered and will produce one complete cycle for every pulse applied or every time the manual button is depressed.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3.0.0 . . . . . OPERATING INSTRUCTIONS

3.1.0 FRONT PANEL FAMILIARITY

3.1.1 Location and Function of Controls

1. Power on/off switch
2. Power ON light indicator
3. Gate/Trigger/Free Run mode selector switch
4. Manual Gate/Trigger pushbutton
5. External Gate/Trigger input jack
6. External Trigger output jack for triggering external equipment.
7. Offset control - provides either positive or negative offset from ground for triangle, ramp or sine out of amplifiers 1 and 2.
8. Symmetry switch - used to convert triangle into a ramp or square wave into a pulse.
9. Multiplier dial - multiplies decade frequency.
10. Decade selector switch - selects any one of ten decade ranges.

3.1.1 Location and Function of Controls (continued)

11. VCF input mode selector - selects one of three voltage-controlled frequency inputs. Selection depends on what type of voltage is available.

12. VCF expansion control - variable sweeping range adjustment. Full maximum gives 50:1 sweep with +5V, -5V or ± 2½V ramp VCF input.

13. VCF input jack

14. VCF sweep direction selector - selects direction of sweep with any given input voltage. Example, in Norm position with a plus ramp input, generator will sweep down in frequency from dial setting. In the Inv position with same plus input voltage, generator will sweep from low end of sweep range (50:1 lower than dial setting) up to expansion ratio set by expansion control. Refer to section 3.3.13 for sweep control characteristics when VCF mode selector switch is in the 0 to -5V and 0 to ±2½V positions.

15. Square amp selector - selects bi-polar square, positive square, negative square. Also selects bi-polar pulse, positive pulse and negative pulse if Sym switch is either Pos or Neg.

16. Square Amp attenuator - attenuates output from max amplitude down to approximately 0. Below 100mv refer to Section 2, Amplitude Adjustment.

17. Square Amp output connector

18. Amplifier 1 selector - selects square, triangle, sine or Amplifier 2. Also selects ramp, reverse ramp and pulse if SYM switch is positive or negative. Amp 1 selector to Tri for ramp, Square for pulse.

19. Amplifier 1 attenuator - attenuates outputs from maximum amplitude down to approximately zero volts. Below 100mv, refer to Section 2, Amplitude Adjustment.

20. Amplifier 1 output connector

21. Amplifier 2 selector - selects square, triangle, sine or Amp 1 Inverted. Also selects ramp, reverse ramp and pulse if Sym switch is Pos or Neg. Amp 1 selector to Tri for ramp or square pulse.

3.1.1 Location and Function of Controls (continued)

22. Amplifier 2 attenuator - attenuates output from maximum amplitude down to approximately zero volts. Below 100mv, refer to Section 2 Amplitude Adjustment.

23. Amplifier 2 output connector.

3.2.0 FIRST TIME OPERATION

3.2.1 A. Set all function generator controls as follows

POWER	ON
MODE	RUN
OFFSET	NORM
SYMMETRY	OFF
MULTIPLIER	X10
DECADE	1K
SWEEP	NORM
VCF MODE	0 to +5V
VCF EXPANSION	MAX
SQ AMP	NORM
SQ AMP ATTENUATOR	MAX
AMP 1	SQ
AMP 1 ATTEN	MAX
AMP 2	SQ
AMP 2 ATTEN	MAX
TRIG OUT	Connect trig out jack to monitor oscilloscope external trigger input. Use coaxial cable.

B. Set oscilloscope as follows

VERTICAL SENSITIVITY	5V/CM
INPUT COUPLING	DC
SWEEP TIME	100μSEC/CM
TRIGGER	EXTERNAL POS

3.2.2 Procedure for producing Bi-Polar Square

A. Same settings as in 3.2.1.

B. Monitor square amp output. Bi-polar square waves are also available from Amp 1 and Amp 2 outputs.

3.2.3 Procedure for producing Positive Square

A. Same settings as in 3.2.1 with exception of SQ AMP selector which should be POS.

3.2.3 Positive Square (continued)

B. Monitor Sq Amp output. A positive square is also available out of Amp 1, negative square from Amp 2.

3.2.4 Procedure for producing Negative Square

A. Same settings as in 3.2.1 with exception of SQ AMP selector which should be NEG.

B. Monitor Sq Amp output. A negative square is also available out of Amp 1, positive square from Amp 2.

3.2.5 Procedure for producing Bi-Polar square pulses

A. Same settings as in 3.2.1 with exception of SYMMETRY switch which should be POS or NEG.

B. Monitor Sq Amp output. Bi-polar square pulse is also available from Amp 1 and Amp 2 outputs.

3.2.6 Procedure for producing Positive Square pulses

A. Same settings as in 3.2.1 with exception of SYMMETRY switch which should be POS or NEG and SQ AMP selector to POS.

B. Monitor Sq Amp output. Positive square pulse is also available from Amp 1 and Amp 2 outputs.

3.2.7 Procedure for producing Negative Square pulses

A. Same settings as in 3.2.1 with exception of SYMMETRY switch which should be POS or NEG and SQ AMP selector to NEG.

B. Monitor Sq Amp output. Negative square pulse is also available from Amp 1 and Amp 2 outputs.

3.2.8 Procedure for producing Sine waveform

A. Same settings as in 3.2.1 with exception of Amp 1 and Amp 2 selectors which are set to SINE.

B. Monitor Amp 1 and Amp 2 outputs. Amp 2 sine will be 180° out of phase with Amp 1.

3.2.9 Procedure for producing Triangle waveform

A. Same settings as in 3.2.1 with exception of Amp 1 and Amp 2 selectors which are set to TRIANGLE.

3.2.9 Procedure for producing Triangle waveform (cont.)

B. Monitor Amp 1 and Amp 2 outputs. Amp 2 triangle will be 180° out of phase with Amp 1.

3.2.10 Procedure for producing Ramp waveforms

Same procedure and settings as in 3.2.9 A-B with exception of SYMMETRY switch which should be POS.

3.2.11 Procedure for producing Reverse Ramp waveform

Same procedure and settings as in 3.2.9 A-B with exception of SYMMETRY switch which should be NEG.

3.2.12 Procedure for Push-Pull operation

Amp 1 and Amp 2 provide push-pull outputs automatically with individual amplitude controls. When Amp 2 is in Amp INV position, you would still have a push-pull output except that amplitudes of both amplifiers can be controlled by Amp 1 attenuator. Amp 2 amplitude attenuator is used for balance. For example, if Amp 1 were set to Sine and Amp 2 set to Amp 1 INV, the unit will produce a push-pull sine output. Amp 1 produces sine at zero degrees while Amp 2 produces sine output at 180 degrees. The attenuator for Amp 2 is now used to match the amplitude of sine waveform out of Amp 1. Adjusting attenuator of Amp 1 will now control amplitude of both waveforms.

3.2.13 VCF Operation (Models 503 and 505 only)

A VCF Mode selector switch provides a selection of input voltages depending on what is available. They are 0 to +5 volts, 0 to -5 volts and 0 to ±2½ volts. INPUT MUST MATCH VCF MODE SELECTOR. When used in conjunction with the sweep switch, the user has a choice of sweeps; he may sweep up in frequency or down in frequency or up and down about a center frequency in the ±2½V position. Center frequency will be approximately one-half dial setting.

Sweep direction vs input voltage:

1. 0 to +5V position - With sweep switch in NORM position and a 0 to plus input voltage, generator will sweep from dial frequency down to low end of sweeping range set by expansion control. In INV position generator frequency will drop to 1/50th of dial setting, then sweep

3.2.13 VCF OPERATION (continued)

up to a frequency to a point set by expansion control. With expansion control fully CW, generator will sweep up to a dial frequency. The INV position requires an external frequency counter to determine exact frequency settings.

2. 0 to -5V position - With sweep switch to NORM the generator will initially drop to approximately 1/50th of dial setting with zero volts input. Precise frequency must be determined with an external frequency counter. When a 0 to minus voltage is applied, the generator will sweep up in frequency to an upper frequency which is set by expansion control. Again, an external frequency counter is required to determine upper frequency.

   With sweep switch to INV position, generator will sweep from dial setting down to a frequency set by the expansion control.

3. 0 to ±2½V position - when VCF mode switch is set to ±2½V with zero volts input, the generator frequency will drop to approximately one-half of dial setting. With sweep switch set to NORM and a ramp input starting at -2½V, the generator will drop in frequency from the center frequency to the low end of the sweeping range, approximately 1/50th of dial setting. As ramp goes positive, generator frequency will increase at a linear rate until the input reaches the +2½V peak, at which time the generator will be at approximately dial setting. When the sweep switch is set to INV the reverse will happen. Exact frequency settings must be determined with an external counter.

3.2.14 Gating, triggering (single shot) 504 or 505

NOTE: LOCKOUT CIRCUITRY WILL NOT FUNCTION PROPERLY WHEN THE OFFSET SWITCH IS IN THE NEG POSITION.

A. Gating operation (D.C. coupled)

1. Switch mode selector to Gate.

2. Monitor any output.

3. Push manual Gate/Trig button and observe output continues as long as depressed.

3.2.14 A. (continued)

4. Once button is released, observe that last cycle is completed before locking out.

5. Using external +5 volts feeding Ext gate input, observe that generator free runs as long as input is applied.

B. Trigger (single shot) operation (A.C. coupled)

1. Switch mode selector to Trig.

2. Monitor any output

3. Push manual Gate/Trig button and observe that a single pulse is generated each time button is depressed.

4. Using external pulse source of +5 volts with a 1μsec risetime or faster, feed Ext input, observing that a single pulse is generated for each external trigger input pulse.

4.0.0 . . . . . CIRCUIT DESCRIPTION AND THEORY

4.1.0 CIRCUIT DESCRIPTION

4.1.1 BLOCK DIAGRAM (refer to drawing 505-100, Section 7).

4.1.2 POWER SUPPLY

The regulated power supply produces all operating voltages required by the instrument. It includes regulated ±18V and unregulated ±30V. The power supply is short circuit protected.

4.1.3 INTEGRATOR

The purpose of the integrator is basically to integrate a square waveform into a linear triangle waveform.

4.1.4 X10 AMP

The X10 Amp is an operational amplifier with a gain variable from 10 to 1. The triangle from the integrator is passed through this amplifier.

This variable gain amplifier causes the triangle amplitude to vary, thus allowing the frequency to be changed.

4.1.5 LEVEL DETECTOR

The function of the Level Detector is to produce a square waveform which is used to connect the + and - VCF supply to the integrator to obtain the triangle waveform.

4.1.6 TIMING AND FEEDBACK CIRCUITRY

The purpose of the timing and feedback circuitry is to connect the integrator and level detector together to make a free-running generator producing square and triangle waveforms plus a method for varying the frequency simultaneously.

The timing circuitry connects the level detector to the integrator circuit. The combination of these circuits produces a free-running oscillator, producing a square waveform and a triangle waveform. (The timing circuitry also provides a method of controlling and varying the frequency of the free-running oscillator circuit.)

4.1.7 SINE SHAPER

The sine shaper is basically an amplifier utilizing the non-linear characteristics of semiconductor

4.1.7 SINE SHAPER (continued)

diodes to cause the amplifier gain to vary non-linearly. The triangle waveform is fed into the sine shaper and the resultant sine waveform is produced.

4.1.8 AMP 1 (non inverting)

Amp 1 is basically a high-gain, wide bandwidth amplifier with negative feedback.

Any of four inputs (square, triangle, sine or the output of the other amplifier) may be selected. The selected waveform is amplified and applied to the output.

The amplifier will drive 600 ohms at greater than 25V P-P and is short-circuit protected. Output amplitude will vary with load.

4.1.9 AMP 2

Amp 2 is essentially identical to Amp 1 but is inverting.

4.1.10 SQUARE AMPLIFIER

The square amplifier is basically an electronic switch. It is driven by the square wave from the level detector. The use of such a circuit produces a good square wave with relatively fast rise and fall times.

Overshoot, ringing and droop are limited by peak clamping of both negative and positive extremes. This amplifier will drive a 600-ohm load at 25V P-P and a 50-ohm load at a lower amplitude. This amplifier is short circuit protected.

4.1.11 VCF AMPLIFIER

The purpose of the VCF Amp is to provide an equal positive and negative voltage which can be varied simultaneously by the application of an external VCF input voltage (voltage controlled frequency).

4.1.12 LOCKOUT AMPLIFIER

The purpose of the lockout amplifier is to enable the generator to lock out (stop running). Two lockout modes are provided, gate and trigger. In the

4.1.12 LOCKOUT AMPLIFIER (continued)

gate mode, the generator can be externally or manually gated on as long as signal is applied. In the trigger mode, the generator will produce one complete cycle each time a signal is received.

4.2.0 CIRCUIT THEORY OF OPERATION

4.2.1 POWER SUPPLY (refer to drawing 505-103)

The power supply produces ±18V and ±30V to the instrument and consists of two basically identical series regulators which produce a low ripple ±18 volts from an unregulated ±30 volt source.

Line voltage is applied to transformer T100 through the ON/OFF switch S100 and fuse F100. The transformer produces 30 volts AC which is fed to rectifier assembly D100 which produces the unregulated ±30V. Capacitors C100 and C110 provide filtering of the unregulated +30V.

Because both the +18V and the -18V regulators are basically identical, only the positive regulator will be discussed here. Q100 is basically a current source. The maximum current is limited by resistor R101.

REGULATOR OPERATION (+18V supply)

A reference voltage of approximately +9V is applied to one side of differential amplifier Q160 and Q180. The reference zener D162 is connected through D121 and voltage divider R123 and R122 to apply approximately +8V on C121 initially to provide a starting voltage for the regulator.

Q160 will supply current to the base of Q120 which will in turn supply voltage to the base of Q140.

Emitter follower Q140 supplies the regulated +18V. The emitter voltage of Q140 is fed through voltage divider R182, R183 and R184.

The arm of R183 is adjustable and provides approximately +9V at the base of Q180 when Q140 emitter voltage is +18V.

If the output voltage increases due to a decrease in load or an increase in line voltage, the base

4.2.1 POWER SUPPLY (continued)

voltage at Q180 will increase, causing the collector current of Q160 to decrease. The base voltage of Q160 is fixed by zener diode D162 at approximately +9V.

With a decrease in collector current of Q160, voltage at the base of Q120 will increase, causing less collector current to flow through Q120 and R124, lowering the voltage at the base of Q140 until the emitter voltage has returned to +18V.

+18V adjust is used to calibrate the power supply to +18V ±3mv. -18V supply operates in essentially the same manner.

4.2.2 INTEGRATOR (refer to drawing 505-101)

The integrator circuit is utilized to produce a very linear output triangle by integrating the square waveform produced by the level detector and the VCF amplifier. The integrator is an operational amplifier.

The operational amplifier Q230 has a matched FET input to obtain a very high input impedance.

Q200 and Q210, matched FET's, provide an extremely high input impedance into the operational amplifier. Feedback from the output emitter follower, Q250 and Q255, is accomplished through the integrating capacitors, C201 through C206, selected by the Decade switch and is also applied to the inverting side of the operational amplifier. This provides negative feedback, forcing the summing junction to remain at virtual ground. The Int Bal control is adjusted to balance the two inputs of the differential operational amplifier.

With the positive VCF supply connected to the timing resistor, the output of the operational amplifier will try to switch negative immediately.

The positive voltage applied to the timing resistor and connected to the summing junction will allow a finite current to flow through the timing resistor. This current will be constant as the VCF voltage is constant and the summing junction is held at virtual ground due to the extremely high gain and negative feedback. Due to the negative feedback through the integrating capacitor, output must charge the integrating capacitor.

4.2.2 INTEGRATOR (continued)

As the timing current flows from the summing junction, an equal but opposite current will be applied through the integrating capacitor in the feedback loop. This feedback current through the integrating capacitor must remain constant as the input timing current is constant. This will cause the output to rise negative charging the capacitor at a constant rate.

The output is connected to the level detector through the X10 Amp. When the X10 Amp output reaches a predetermined level, the level detector will change state and invert the square waveform applied to the switching bridge. This will in turn reverse the operation described and the integrator output will reverse and start rising positively thus producing a linear triangle waveform at the output.

By switching in different timing resistors and integrating capacitors, frequency can be changed in decade steps. By varying the Multiplier dial, the triangle amplitude applied to the integrating capacitors is changed causing a linear change in timing current and thereby changing frequency. By switching resistors and capacitors with the Decade switch and adjusting the Multiplier dial, any desired frequency from 0.0001 to 1MHz may be obtained.

The Sym switch, S560, is provided to produce non-symmetrical operation required for the various non-symmetrical waveforms such as the ramp, reverse ramp and square waveform pulses. Switch S560 enables the VCF voltage to be connected directly to the summing junction, by-passing the timing resistor.

When S560 is switched to the negative position, R575 connects the applied negative VCF voltage directly to the summing junction.

When the positive VCF voltage is connected, the timing resistor will be by-passed by R575, a 10K resistor, causing a much larger timing current to flow. The output of the integrator will rise positive much faster as a result of the increased timing current.

When the output of the X10 Amp reaches the trip point of the level detector, the VCF supply will

4.2.2 INTEGRATOR (continued)

reverse polarity as previously described. With the negative VCF supply now connected, the integrator will integrate at the same rate as in the NORM position.

4.2.3 X10 AMP (refer to drawing 505-101)

The purpose of the X10 Amp is to vary the amplitude of the triangle wavefrom from the output of the integrator. The amplitude of the triangle waveform from the integrator determines the amount of time required to charge the feedback capacitor. If the amplitude of this triangle changes, the frequency will change.

The X10 Amp is composed of Q260, Q280 and Q290. Q260 is an operational amplifier with a fixed gain of approximately 10.

The output of the X10 Amp is fed through output emitter followers Q280 and Q290 to the input of the level detector. The triangle amplitude at the input of the level detector will remain constant as this is controlled by the level detector trip points.

R261 (multiplier) and R263 form a voltage divider to the input of the operational amplifier. With the arm of the Mult control set at maximum (X10), the triangle amp at the output of the Integrator will be minimum. A .4V P-P triangle would produce a 4V P-P triangle at the X10 Amp output.

With the Mult set at minimum (X1), approximately a 4V P-P triangle waveform will be required to drive the output of the X10 amplifier to 4V P-P. It takes much longer to charge the feedback capacitor to 4V P-P than to .4V P-P. In this manner, the Mult in conjunction with the X10 Amp varies the frequency of the generator manually.

4.2.4 LEVEL DETECTOR (refer to drawing 505-103)

The level detector is used in conjunction with the integrator to produce a free-running square and triangle waveform.

The input to the level detector is connected to the output of the X10 Amp. Q300 is a constant current source for differential amplifier Q310 and Q320. Q340 and Q350 form a second differential

4.2.4 LEVEL DETECTOR (continued)

amplifier which is connected to Q310 and Q320 to form a high-gain amplifier circuit.

The output voltage swing of Q340 and Q350 collectors are both clamped by a diode bridge to approximately ±1.5V P-P.

Positive feedback is used to obtain very fast switching.

With the input rising positive, Q310 will turn off and Q320 will turn on. Once Q310 is turned off, the collector voltage of Q310 will go negative. This will in turn cause Q350 base to go negative, causing Q350 to turn off and Q340 to conduct harder. Q340 collector voltage will go farther negative, causing Q320 base to go negative and Q320 to conduct harder. Positive feedback Q350 collector voltage will increase due to Q350 turning off. This in turn causes the output to switch to its positive state.

A positive input waveform causes the output to switch positive when the input trip point is reached (inverting). In this manner, the integrator, X10 Amp and the level detector create a free-running square and triangle waveform simultaneously.

Q340 collector signal is applied to the output emitter follower which drives the square amplifier and produces the trigger out signal.

4.2.5 SINE SHAPER

The sine shaper is basically a differential operational amplifier with non-linear feedback which will produce a low-distortion sine wave from a linear triangle input.

Transistors Q600, Q610 and Q620, Q630 are two differential amplifiers connected together to form a high-gain amplifier.

With the input rising at a constant slope (positive triangle), Q630 collector voltage will go negative. As the output rises negatively, the feedback network voltage divider will essentially connect smaller and smaller resistance across the fixed gain feedback resistor R674, thus causing the gain to decrease as the output voltage rises negatively.

4.2.5 SINE SHAPER (continued)

When the input triangle changes slope, the output will simply reverse polarity and rise positive, producing the same non-linear action. The constantly changing gain of the amplifier will produce the required sine waveform.

Q640 emitter follower and Q650 constant current source provide the necessary current to drive the feedback network. Q660 and Q670 emitter followers provide the moderately low output impedance to drive the associated circuitry.

4.2.6 SQUARE AMPLIFIER

The square amplifier is essentially a high-speed switch which produces a 28V P-P output square wave at less than 50 nanosecond rise and fall times.

The squarewave from the level detector is fed into the square amplifier input. With the squarewave in its positive state, Q800 will turn on, causing Q800 collector to go negative. This negative signal at Q800 causes Q810 to saturage, thus pulling the collector voltage of Q810 positive very rapidly. The positive input signal will hold Q830 off as long as the input remains positive. When the input switches negative, Q840 collector will switch negative very rapidly.

This squarewave is applied through selector switch S810 to the output emitter follower.

4.2.7 SQUARE SELECTOR SWITCH S810

When switched to the POS SQ position, a diode is in series with the squarewave being applied to the output emitter follower. This will allow signal to pass in only one direction.

When the selector switch is placed in the NEG SQ position, only the negative portion of the square waveform will pass to the emitter follower and on to the output.

4.2.8 AMP 1 (non inverting)

Amp 1 provides the selected waveform at 28V P-P into 600 ohms at the output.

4.2.8 AMP 1 (continued)

The signal is applied at the input to Amp 1 (TP900). A positive signal will cause Q900 to turn on, driving Q910 collector positive. This amplified signal is applied to output buffer Q920 and Q950 which drive Amp 1 output. The gain is fixed by R941 and R931 to approximately 3.

4.2.9 AMP 2 (inverting)

Amp 2 also provides the selected waveform at 28V P-P into 600 ohms at the output (inverted).

The signal is applied to the emitters of input transistors Q700 and Q730. Q700 and Q730 bases are grounded.

A positive signal will cause Q700 to turn off. This will cause Q710 to turn off driving the output negative. This signal is applied to the output buffer Q720 and Q750 which drive the output of Amp 2.

The gain is fixed at approximately 3 as in Amp 1.

4.2.10 VCF AMP

The VCF Amp provides a ± voltage to the timing resistors which can be varied causing the frequency to change.

Q500 differential amplifier is connected to Q540 to form the positive VCF supply amplifier. Q530 is a constant current source for Q500. With Q500 output base grounded, a positive signal at Q500 input base will cause Q580 input transistor to turn on, driving Q540 base negative and the output positive. Negative feedback (R544, R547) fixes the gain at about 4.

With the input grounded, the output will be approximately 500mv. With a +5V signal at the input, the output will be at +16V. The negative supply is composed of transistors Q550, Q560 and Q580.

A voltage divider (R562, R563, R581) is connected from the +16V supply to the -16V supply. Base of Q560 will set at about zero volts due to the voltage divider. +16V supply will cause Q560 to turn off driving Q580 base negative, driving output of

4.2.10 VCF AMP (continued)

Q580 negative. When the output reaches -16V, voltage at the base of Q560 will reach zero volts and thus maintain the negative supply at -16V as long as +16V supply remains at +16V. In this manner, the negative supply will track the positive supply and always provide an equal but opposite voltage.

As VCF input voltage varies from zero volts to +5V, VCF supply voltages will vary from ±16V to approximately ±500mv.

The VCF mode switch provides three different modes of operation so that the user may operate the VCF with virtually any signal input.

4.2.11 LOCKOUT AMPLIFIER

The lockout amplifier is composed of Q400, Q410, Q420, Q430, Q440, Q450 and Q460.

The output of the integrator (TP250) is connected to the input of differential amplifier Q460 and Q450. The base of Q450 is connected to ground through R443 (1K).

The summing junction of the integrator is connected to the collector of Q450 through a pair of diodes (D452, D453).

If the two diodes become forward biased, they will prevent any further timing current at the summing junction, thus causing the integrator to stop integrating.

The collector of Q450 must reach approximately +1V or greater to lockout the generator.

The signal at Q460 base is the triangle waveform from the integrator output. The triangle at this point will vary from approximately ±400mv P-P to ±4V P-P.

C440 provides offset to Q450 base preventing lockout when in the Run mode of operation. In the Run mode +18V is applied at Q400 base. Q400 will turn on, which in turn turns on Q440 driving the base of Q450 positive, preventing lockout.

When in the Gate mode of operation, the input of Q400 is connected to the EXT input jack.

4.2.11 LOCKOUT AMPLIFIER (continued)

With no signal applied at Q400 base Q400 will turn off, which in turn causes the base of Q450 to return to ground potential. Now the generator will lock out as the triangle rises positive, turning off Q460, thus turning on Q450 and forward biasing the lockout diodes.

An input voltage of approximately +5V or greater applied at the EXT input jack will cause the generator to free run as previously explained as long as the signal is applied.

The generator can be turned on manually by depressing the manual pushbutton switch, applying +18V to the input. The generator will continue to run as long as the pushbutton is depressed.

When the Mode switch is placed in the Trig position, the input becomes AC coupled.

A positive signal applied at the input will cause Q400 to turn as previously described. The Multi action of Q410, Q420 and Q430 will cause Q410 to turn on and remain on until a positive signal is applied at Q430 base allowing Q410 to turn off and the generator to lock out.

The timing square wave is in the Neg position (-16V supply connected) when the generator locks out. The generator will lock out when the triangle rises to zero volts.

Q400 turning on will allow the generator to start running again as previously described. The triangle will continue rising positive until the positive trip point is reached at the level detector input.

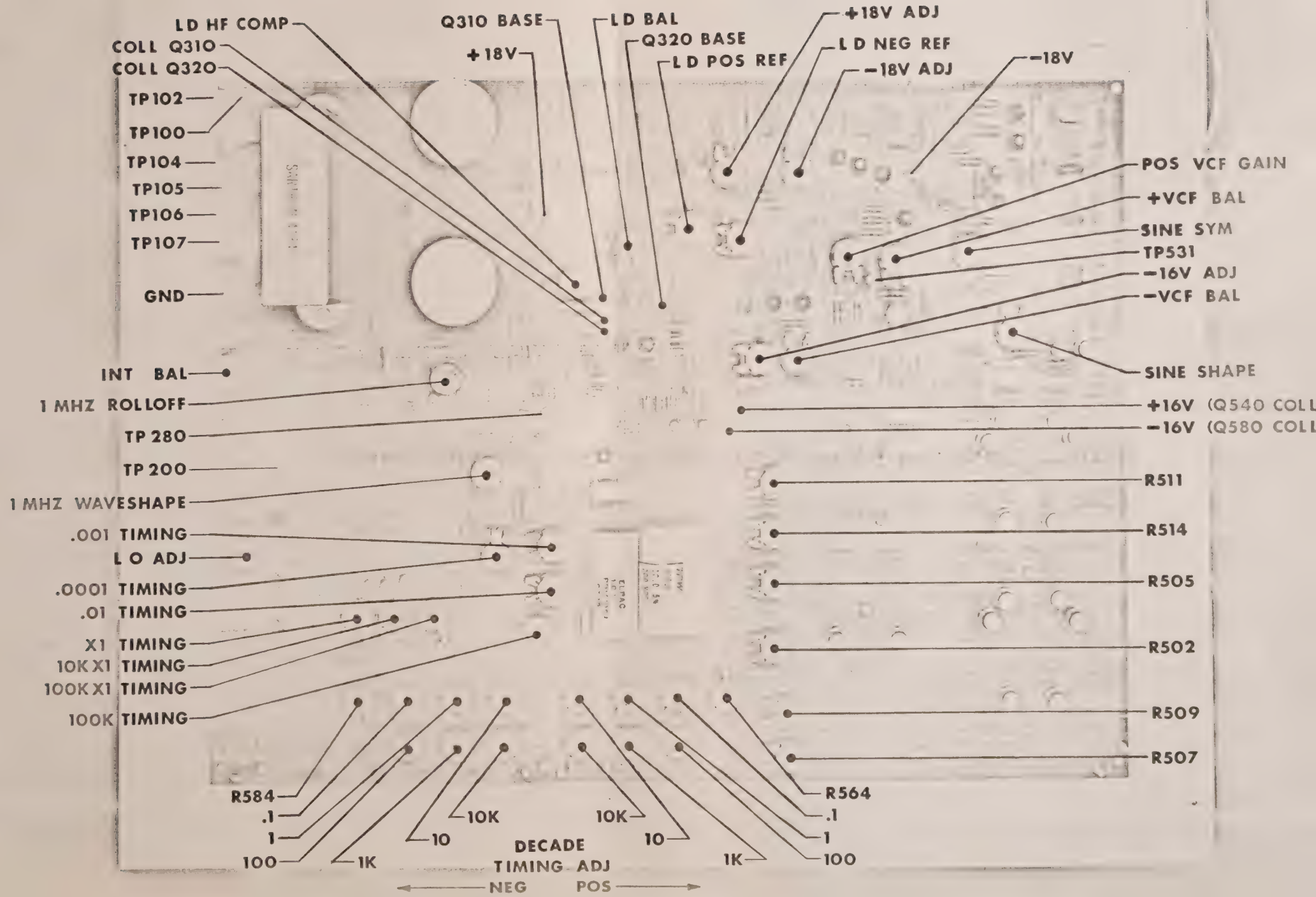
The timing square will now reverse polarity (positive) and connect the +16V supply, thus reversing action. The triangle now integrates negatively until the negative trip point is reached. The -16V is again connected, causing the triangle to integrate positive.

When the timing square switched negative, the square wave at Q360, Q370 switched positive (inverted). This square wave is connected to Q430 base through C431, a 68pf capacitor. A positive pulse will turn Q430 on and Q410 off, thus placing the lockout amplifier in a lockout condition. When the

4.2.11 LOCKOUT AMPLIFIER (continued)

triangle reaches zero volts, lockout will occur. Thus, one complete cycle is generated each time a pulse is applied at the EXT input jack or the manual pushbutton is depressed.

NOTE: INPUT PULSE RISETIME MUST BE 100nsec OR FASTER.


LD HF COMP
COLL Q310
COLL Q320
TP102
TP100
TP104
TP105
TP106
TP107
GND
Q310 BASE
+18V
LD BAL
Q320 BASE
LD POS REF
+18V ADJ
LD NEG REF
-18V ADJ
-18V
POS VCF GAIN
+VCF BAL
SINE SYM
TP531
-16V ADJ
-VCF BAL
SINE SHAPE
+16V (Q540 COLL
-16V (Q580 COLL
INT BAL
1 MHZ ROLLOFF
TP 280
TP 200
1 MHZ WAVESHAPE
.001 TIMING
L O ADJ
.0001 TIMING
.01 TIMING
X1 TIMING
10K X1 TIMING
100K X1 TIMING
100K TIMING
R511
R514
R505
R502
R509
R507
R564
.1
1
100
1K
10K
10
DECADE
TIMING ADJ
NEG
POS
R584
.1
1
100
1K
10K
10

5.0.0 . . . . . CALIBRATION AND MAINTENANCE

5.1.0 FAILURE TO OPERATE

Read operating instructions to insure a thorough understanding of all front panel controls.

Should instrument fail to have an output from any of three amplifier outputs, check the following.

A. Unplug instrument and check 117V 3AG 1/2 amp fuse, or 3AG 1/4 amp for 220V operation, located on rear panel.

B. Remove cover and check for 117V AC between TP100 and 102. This checks power line cord.

Measure between TP104 and 107 for 117V AC. This check is for power on/off switch and associated wire. It insures that power is going into power transformer.

If trouble is not located in above steps, follow calibration procedure until trouble is located.

5.2.0 FAILURE TO MEET FACTORY SPECIFICATIONS

Check the following.

A. Proper operating instructions in Section 3 to insure a thorough understanding of all front panel controls.

B. Perform all steps of calibration procedure. If instrument still does not meet specifications, contact factory and arrange to return for a complete check-out and evaluation.

5.3.0 CALIBRATION PROCEDURE

The following test equipment or suitable equivalents of known accuracy are required for complete calibration of the Types 503, 504 and 505 function generators.

A. Oscilloscope, DC to 100MHz, Tektronix 547 with 1A1 plug-in.

B. Distortion Analyzer, Hewlett Packard 333A.

C. Variac Powerstat

D. Constant current DC source accurate to 1mv.

E. Frequency Counter, CMC 607A.

F. Differential voltmeter, Medistor A-50.

5.3.0 CALIBRATION PROCEDURE (test equipment continued)

G. VOM, Simpson 260

H. 600-ohm purely resistive load

5.3.1 POWER SUPPLY

NOTE: Instrument should be ON for at least thirty minutes before any of the following adjustments is made.

A. +18-volt calibration

1. Connect differential voltmeter to +18V test point.

2. Adjust +18 ADJ to obtain +18V ±2mv.

B. -18-volt calibration

1. Connect differential voltmeter to -18V test point.

2. Adjust -18V ADJ to obtain -18V ±2mv.

C. Line regulation check

1. Connect differential voltmeter to +18V test point.

2. Using Variac, vary line voltage from 105V to 125V while monitoring supply voltage. Supply voltage should remain constant ±10mv.

3. Connect differential voltmeter to -18V test point.

4. Using Variac, vary line voltage from 105V to 125V while observing -18V supply voltage. Supply voltage should remain constant ±10mv as in step 2.

D. Power supply ripple check

Set oscilloscope controls as follows

VERTICAL SENSITIVITY	MAX
INPUT COUPLING	AC
SWEEP TIME	10MSEC/CM
TRIGGER	LINE

5.3.1 D. (continued)

Measure 120Hz ripple content of the +18V and -18V supply.

Ripple on each supply should be less than 5mv.

5.3.2 INTEGRATOR BALANCE

A. Using a short jumper lead, connect test point TP200 to nearest ground test point.

B. Connect a VOM to test point TP280.

C. Adjust INT BAL ADJ to obtain 0 volts ±100mv.

D. Remove jumper.

5.3.3 LEVEL DETECTOR BALANCE

A. Using short jumper leads, connect the base of transistors Q310 and Q320 to nearest ground.

B. Adjust L.D. BAL ADJ to obtain equal voltages ±50mv at the collectors of Q310 and Q320 (approximately -5V). Measure with VOM.

5.3.4 LEVEL DETECTOR POSITIVE AND NEGATIVE REFERENCE ADJ

A. Set oscilloscope controls as follows, using a differential plug-in such as Tektronix Type Z or equivalent.

VERT	MAX SENSITIVITY DIFFERENTIAL MODE
INPUT COUPLING	DC
SWEEP TIMING	.1MSEC/CM
TRIGGER	EXT POS
Monitor test point 280	

B. Set function generator controls as follows

MODE	RUN
MULTIPLIER	X10
DECADE	1K
OFFSET	NORM
SYMMETRY	NORM
VCF MODE	OFF
SWEEP	NORM

C. Adjust L.D. POS REF ADJ until the positive peak of the triangle is +4 volts ±10mv as observed on oscilloscope.

5.3.4 (continued)

D. Adjust L.D. NEG REF ADJ until the negative peak of the triangle is -4 volts ±10mv as observed on oscilloscope.

5.3.5 VCF PRELIMINARY ADJUSTMENT

A. Set function generator controls as follows.

MODE	RUN
MULTIPLIER	10
DECADE	100
OFFSET	NORM
SYMMETRY	NORM
VCF MODE	OFF
SWEEP	NORM

B. Using a jumper lead, connect TP531 to nearest ground.

C. Connect a differential voltmeter to the collector of Q540 (+16V).

D. Adjust the POS VCF BAL ADJ to obtain 0 V ±50mv.

E. Remove jumper lead.

F. Set VCF GAIN ADJ and -VCF BAL ADJ to mid range.

G. Adjust +16V ADJ to obtain +16V ±3mv at Q540 collector (+16V).

H. Connect the differential voltmeter to the collector of Q580.

J. Adjust the -16V ADJ to obtain -16V ±3mv.

K. Set controls as follows

VCF MODE	0 to +5V
SWEEP	INV
EXPANSION	FULL CW
INPUT VOLTAGE	GND

L. Adjust -VCF BAL ADJ to obtain equal voltages ±2mv at Q580 and Q540 collectors. (+16V and -16V supplies). Use a differential voltmeter to measure these voltages of approximately 300mv.

M. Set controls as follows

VCF MODE	OFF
SWEEP	NORM

Repeat steps G through L.

5.3.6 MULTIPLIER DIAL ADJUST

A. Set controls as follows

MODE	RUN
DECADE	100
OFFSET	NORM
SYMMETRY	NORM
VCF MODE	OFF
SWEEP	NORM

B. Remove multiplier dial control and rotate multiplier control shaft full CW.

C. Monitor generator frequency using a frequency counter at square amp out.

D. Rotate multiplier control shaft CCW until the frequency has decreased approximately 3%.

E. Replace multiplier dial carefully without moving multiplier control shaft. Align the X10 on the dial skirt directly in line with index mark on the front panel. Tighten both set screws, being careful not to move multiplier control shaft.

F. With multiplier set on X10, adjust 100 TIMING ADJ controls to obtain a frequency of 1KHz ±.5% and symmetrical ±.5%.

G. Set MULT to X1.

H. Adjust ~~100~~ X 1 ADJ to obtain 100Hz ±.5%.

J. Set multiplier on X10.

5.3.7 TIMING

A. Set controls as follows

MODE	RUN
DECADE	1K
MULTIPLIER	10
OFFSET	NORM
SYMMETRY	NORM
VCF MODE	OFF

NOTE: Steps 5.3.1 through 5.3.6 must be completed before final timing is started.

5.3.7 TIMING (continued)

B. Connect frequency counter to monitor generator frequency at square amp output.

C. Adjust decade range timing adjustments (two per decade) to obtain the following frequencies as read on frequency counter.

	Decade	Adj	To Obtain	Symmetry
	1K	1K timing adj	10KHz ±.5%	±.5%
	100	100 "	1KHz ±.5%	±.5%
	10	10 "	100Hz ±.5%	±.5%
	1	1 "	10Hz ±.5%	±.5%
	.1	.1 "	1Hz ±.5%	±.5%
*	.01	.01 "	.1Hz ±.5%	
*	.001	.001 "	.01Hz ±.5%	
*	.0001	.0001 "	.001Hz ±.5%	

*NOTE: Adjust R584 and R564 to obtain correct symmetry ±.5% before adjusting timing on lower three decades.

D. Set Multiplier to X1 and check all decade positions checked for correct frequency and symmetry as stated in specifications.

E. Set Decade to 100K and Multiplier to 10.

F. Set oscilloscope as follows.

VERTICAL SENSITIVITY	2V/CM
INPUT COUPLING	DC
SWEEP TIMING	.2MSEC/CM
TRIGGERING	EXT

Monitor TP280, X10 amp output

Adjust 1MHz Rolloff trimmer capacitor to obtain optimum triangle waveform, free of oscillations.

G. Adjust 1MHz Waveshape trimmer capacitor to obtain optimum triangle waveform linearity.

H. Adjust L.D.H.F. COMP trimmer capacitor to obtain an 8V P-P ±20mv triangle waveform.

J. Adjust 100K Timing Adj trimmer capacitor to obtain 1MHz ±.5%.

K. Repeat steps D through J.

L. Set Multiplier to X1 and adjust 10K X 1 ADJ to obtain 100KHz ±.5%.

5.3.7 TIMING (continued)

M. Set Decade on 10K and Multiplier on X10.

N. Adjust 10K Timing Adj controls to obtain 100KHz ±.5% and symmetrical ±.5%.

P. Set Multiplier to X1 and adjust 10K X 1 Adj to obtain 10KHz ±.5%.

5.3.8 VCF MODE CALIBRATE

A. 0 to +5V Mode

Set controls as follows

MODE	RUN
DECADE	1K
MULTIPLIER	10
VCF MODE	0 to +5V
SWEEP	NORM
VCF INPUT VOLTAGE	+5V ±2mv*

*NOTE: VCF input voltage must be constantly monitored with a differential voltmeter as loading, etc., can effect the input voltage.

1. Connect frequency counter to monitor generator output frequency.

2. Adjust VCF expansion control (front panel) to obtain 200Hz ±1% as read on counter.

NOTE: VCF input voltage may have to be readjusted until correct frequency and input voltage are attained simultaneously.

3. Set SWEEP to INV. Readjust +5V ±3mv at input if necessary. Do not move expansion control.

4. Adjust R507 until the generator frequency is 10KHz ±.5%.

B. 0 to ±2.5V mode

Set controls as follows

VCF MODE	0 to ±2.5V
SWEEP	NORMAL
EXPANSION	FULL CW
INPUT VOLTAGE	0 V (gnd)

5.3.8 VCF MODE (B continued)

1. Adjust R505 to obtain frequency of 5KHz ±.5%.

2. Set SWEEP switch to INV position. The frequency should be 5% to 15% higher than in Step 2 (no adjustment).

3. Apply +2.5V ±3mv at VCF input.

4. Adjust VCF expansion control to obtain 200Hz ±1%.

5. Apply -2.5V ±3mv at VCF input. The frequency should be 10KHz ±2% (no adjustment).

6. Set SWEEP to INV.

7. Apply -2.5V ±3mv at VCF input.

8. Adjust VCF EXPANSION control to obtain 200Hz ±1%.

9. Apply +2.5V ±3mv at VCF input. The frequency should be 10KHz ±5% (no adjustment).

C. 0 to -5V mode

Set controls as follows

VCF MODE	0 to -5V
SWEEP	INV
EXPANSION	FULL CW
INPUT VOLTAGE	0 V (gnd)

1. Adjust R509 to obtain 10KHz ±.5%.

2. Apply -5V ±3mv at VCF input.

3. Adjust R502 to obtain 200Hz ±1%.

4. Set SWEEP to NORM position.

5. Adjust R511 to obtain 200Hz ±1%.

6. Apply -5V ±3mv at VCF input. The frequency should be 10KHz ±10% (no adjustment).

5.3.9 SYMMETRY MODES

NOTE: No adjustment necessary

Set function generator controls as follows.

MODE	RUN
DECADE	1K
MULTIPLIER	10
SYMMETRY	NORM
OFFSET	NORM
VCF MODE	OFF
AMP 1	TRIANGLE
AMP 1 ATTENUATOR	MAX

Set oscilloscope controls as follows

VERTICAL SENSITIVITY	5V/CM
INPUT COUPLING	DC
SWEEP TIME	10MSEC
TRIGGER	EXT POS

Monitor Amp 1 output

The following waveforms should be observed, depending upon the position of the Symmetry switch.

5.3.10 OFFSET MODES

NOTE: No adjustment necessary

Set oscilloscope and generator controls as in 5.3.9.

The following waveforms should be observed, depending upon the position of the offset switch.

5.3.11 SINE SHAPER

A. Set generator controls as follows

MODE	RUN
DECADE	100
MULTIPLIER	10
SYMMETRY	NORM
OFFSET	NORM
VCF MODE	OFF
AMP 1	SINE
AMP 1 ATTENUATOR	MAX

B. Set oscilloscope as follows

VERTICAL SENSITIVITY	5V/CM
INPUT COUPLING	DC
SWEEP TIME	.2MSEC
TRIGGER	EXT POS
Monitor Amp 1 output	

C. Connect a distortion analyzer to Amp 1 output.

D. While observing waveform, adjust the Sine Shape and Sine Sym to obtain minimum distortion as indicated on distortion analyzer. Distortion should be less than .7%.

5.3.12 LOCKOUT AMP

NOTE: Lockout will not operate properly when the offset switch is in the negative position.

A. Set generator controls as follows

MODE	GATE
DECADE	100
MULTIPLIER	10
SYMMETRY	NORM
OFFSET	NORM
VCF MODE	OFF
AMP 1	TRIANGLE
AMP 1 ATTENUATOR	MAX

B. Set oscilloscope controls as follows

VERTICAL SENSITIVITY	5V/CM
INPUT COUPLING	DC
SWEEP TIME	.2MSEC
TRIGGER	EXT POS
Monitor TP280	

C. Connect VOM to TP280.

5.3.12 LOCKOUT AMP (continued)

D. Adjust L.O. ADJ to obtain 0 V ±20mv.

E. Depress manual gate/trig button to insure that generator free runs as long as button is depressed.

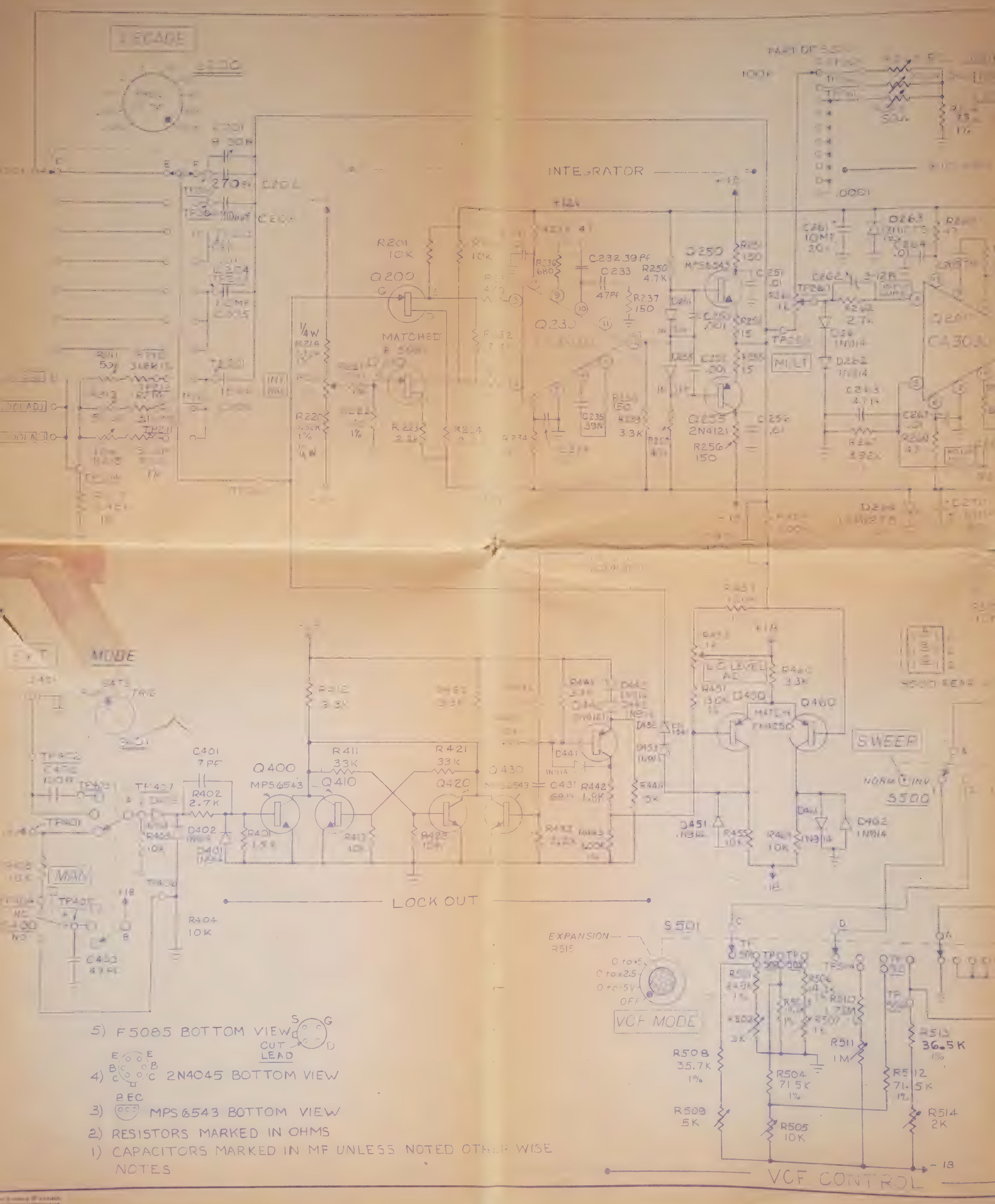
F. Switch Mode selector to Trig. Check to insure that a single pulse is generated at all outputs each time the manual gate/trig button is depressed. Oscilloscope triggering is very sensitive and critical in monitoring single pulse.

G. Using external voltage feeding ext input, check to insure that Gate function operates with a minimum of +4V input. Do not exceed 20V input or damage to instrument may occur.

H. Using external square pulse with 100nsec rise-time or faster feeding external input, check trig function to insure that a single pulse is generated at all outputs for each input pulse of +3V or greater. Do not exceed 20V input voltage.

J. The operation of the gate and trigger mode is explained fully in the first time operation section.

5.3.13 Monitor Trig output and check for a .7V differentiated square wave. No calibration required.



INTEGRATOR
+12V
R201
10K
Q200
MATCHED
C232 39PF
C233
47PF
R250
4.7K
R237
150
R236
680
Q230
Q250
MPS6543
R251
150
C251
.01
Q255
2N4121
R256
150
C256
.01
C235
39PF
3.3K
R220
1%
1/4W
R214
R223
2.2K
C261
10MF
20V
D263
C264
.01
R262
2.7K
D262
1N914
C263
4.7PF
R264
392K
C267
R260
47
CA3030
MULT
TP261
PART OF S501
.0001
100K
R411
33K
R421
33K
Q400
MPS6543
Q410
Q420
Q430
C401
7PF
R402
2.7K
D402
R401
1.5K
R404
10K
C453
47PF
LOCK OUT
C431
68PF
R442
1.0K
R444
5K
D441
1N914
D451
1N914
R455
10K
R460
3.3K
Q450
Q460
MATCH
SWEEP
NORM
INV
S500
D462
1N914
R461
10K
S501
EXPANSION
R515
0 to +5
0 to ±2.5
0 to -5V
OFF
VCF MODE
R508
35.7K
1%
R509
5K
R504
71.5K
1%
R505
10K
R511
1M
R512
71.5K
1%
R513
36.5K
1%
R514
2K
-18
VCF CONTROL
MODE
MAN

5) F5085 BOTTOM VIEW

CUT LEAD

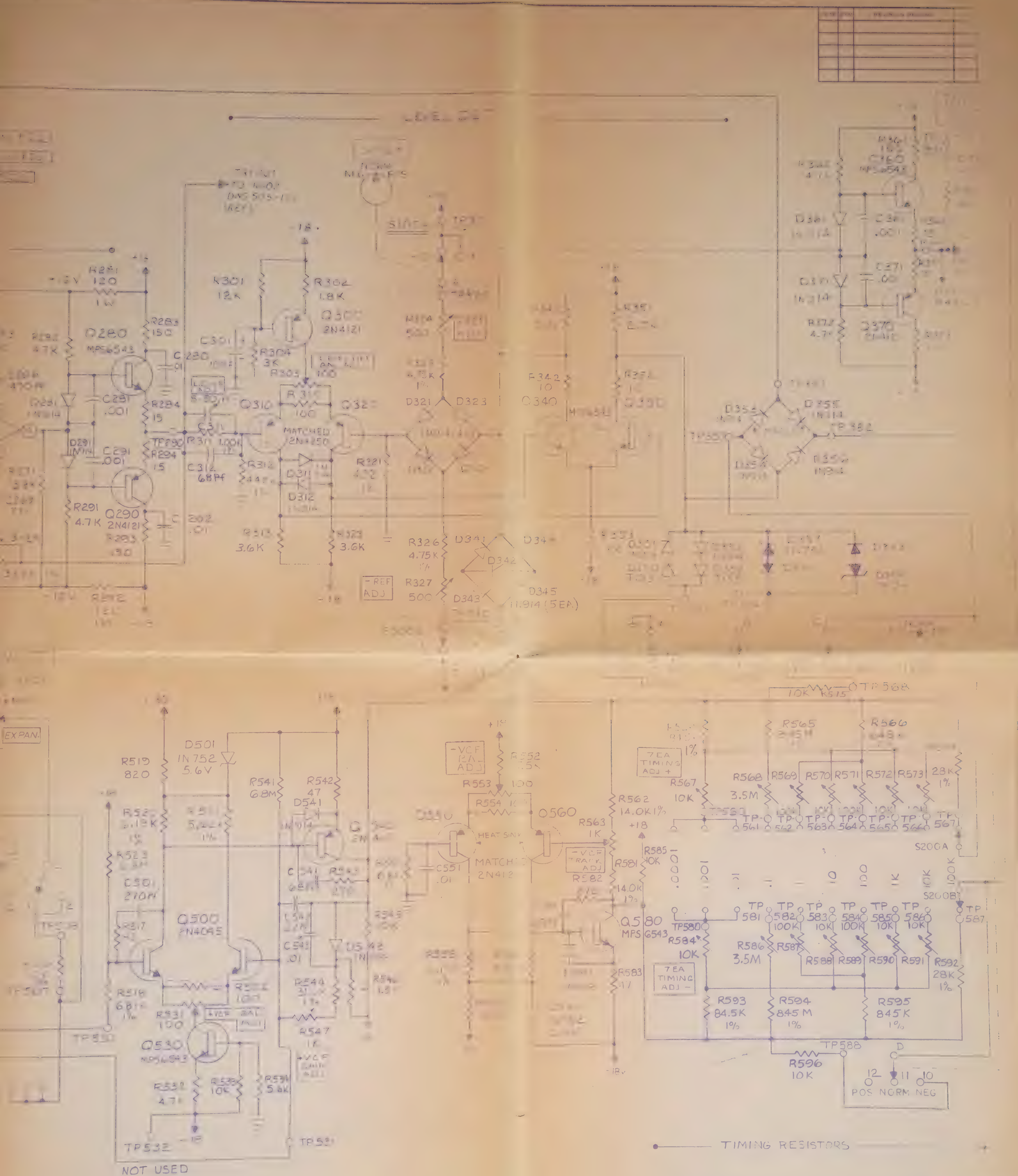
4) 2N4045 BOTTOM VIEW

3) MPS6543 BOTTOM VIEW

2) RESISTORS MARKED IN OHMS

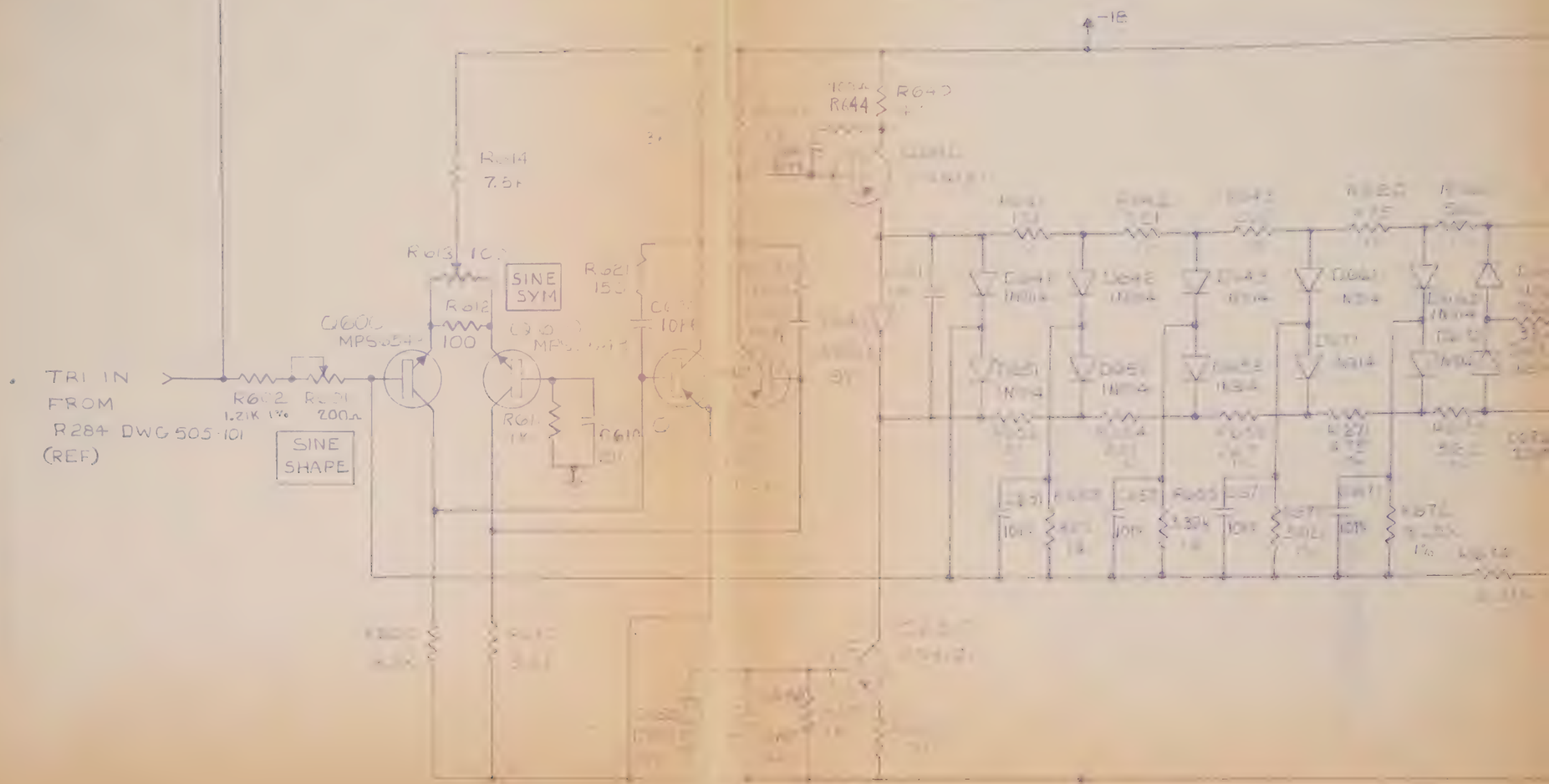
1) CAPACITORS MARKED IN MF UNLESS NOTED OTHER WISE

NOTES

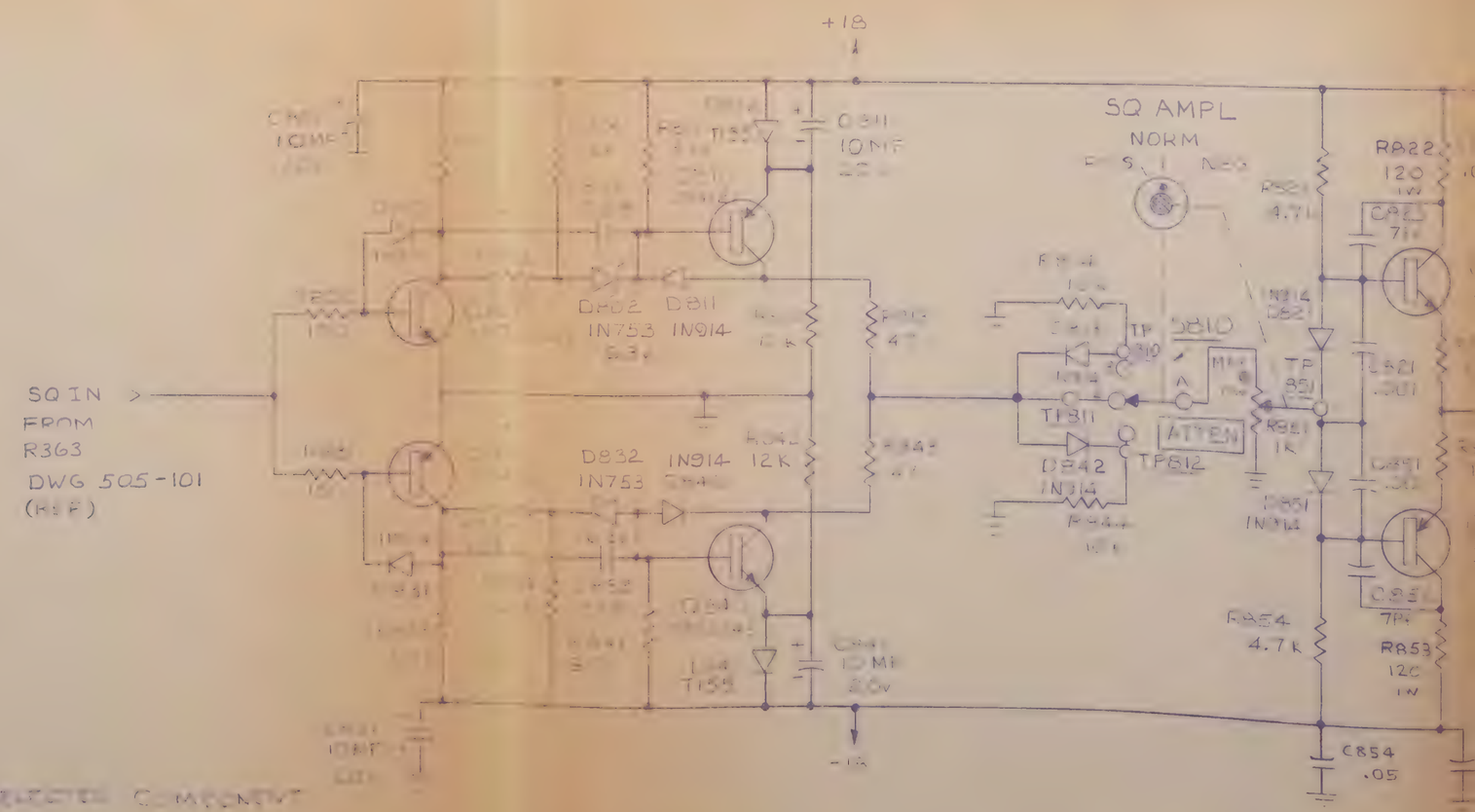

LEVEL DET
R281 120 1W
R282 4.7K
Q280 MPS6543
R283 150
C280 .01
C281 .001
D281 1N914
D291 1N914
C291 .001
R284 15
TP290
R294 15
R291 4.7K
Q290 2N4121
R301 12K
R302 1.8K
Q300 2N4121
R304 3K
Q310
MATCHED 2N4250
C311
R311 1.00K
C312 68PF
R312
R313 3.6K
R321
D311
D312
R323 3.6K
D321
D323
R326 4.75K 1%
R327 500
-REF ADJ
D341
D342
D343
D345 1N914 (5EA)
F342 10
C340
Q350
D354
D355 1N914
TP352
D356 1N914
Q360 MPS6543
R362 4.7K
D361
C361 .001
D370 1N914
C371 .001
R372 4.7K
Q370
EXPAN.
R519 820
D501 1N752 5.6V
R541 6.8M
R542 47
D541
R521
R523
C501 270PF
R517
Q500 2N4045
R516 681 1%
TP530
R531 100
Q530 MPS6543
R532 4.7K
R533 10K
R534 5.6K
TP532
NOT USED
TP531
C541
C542
C543 .01
D542
R544
R545 10K
R547 1K
+VCF GAIN ADJ
-VCF BAL ADJ
R552 75
R553 100
R554
Q550
C551 .01
HEAT SINK
MATCHED 2N4121
Q560
R562 14.0K 1%
R563 1K
+18
-VCF TRACK ADJ
R581
R582
R585 10K
14.0K 1%
Q580 MPS6543
R583
-18V
10K R515 TP568
R565 845M
R566 848K
7EA TIMING ADJ +
R567 10K
R568 3.5M
R569
R570
R571
R572
R573
28K 1%
TP561
TP562
TP563
TP564
TP565
TP566
TP567
S200A
.0001
.001
.01
.1
1
10
100
1K
10K
100K
S200B
TP587
TP580
R584 10K
7EA TIMING ADJ -
TP581
TP582 100K
TP583 10K
TP584 100K
TP585 10K
TP586 10K
R586 3.5M
R587
R588
R589
R590
R591
R592 28K 1%
R593 84.5K 1%
R594 845M 1%
R595 845K 1%
TP588
R596 10K
D
12 11 10
POS NORM NEG
TIMING RESISTORS
VCF AMPL

TOLERANCES (EXCEPT AS NOTED)			
DECIMAL ±		SCALE	DRAWN BY / APPROVED BY
FRACTIONAL ±	TITLE SCHEMATIC - INTEGRATOR, LEVEL DET, VCF, And LOCKOUT		
ANGULAR ±	DATE	DRAWING NUMBER 505 - 101	

SINE SHAPER



SQUARE AMPLIFIER



4) ★ DENOTES SELECTED COMPONENT

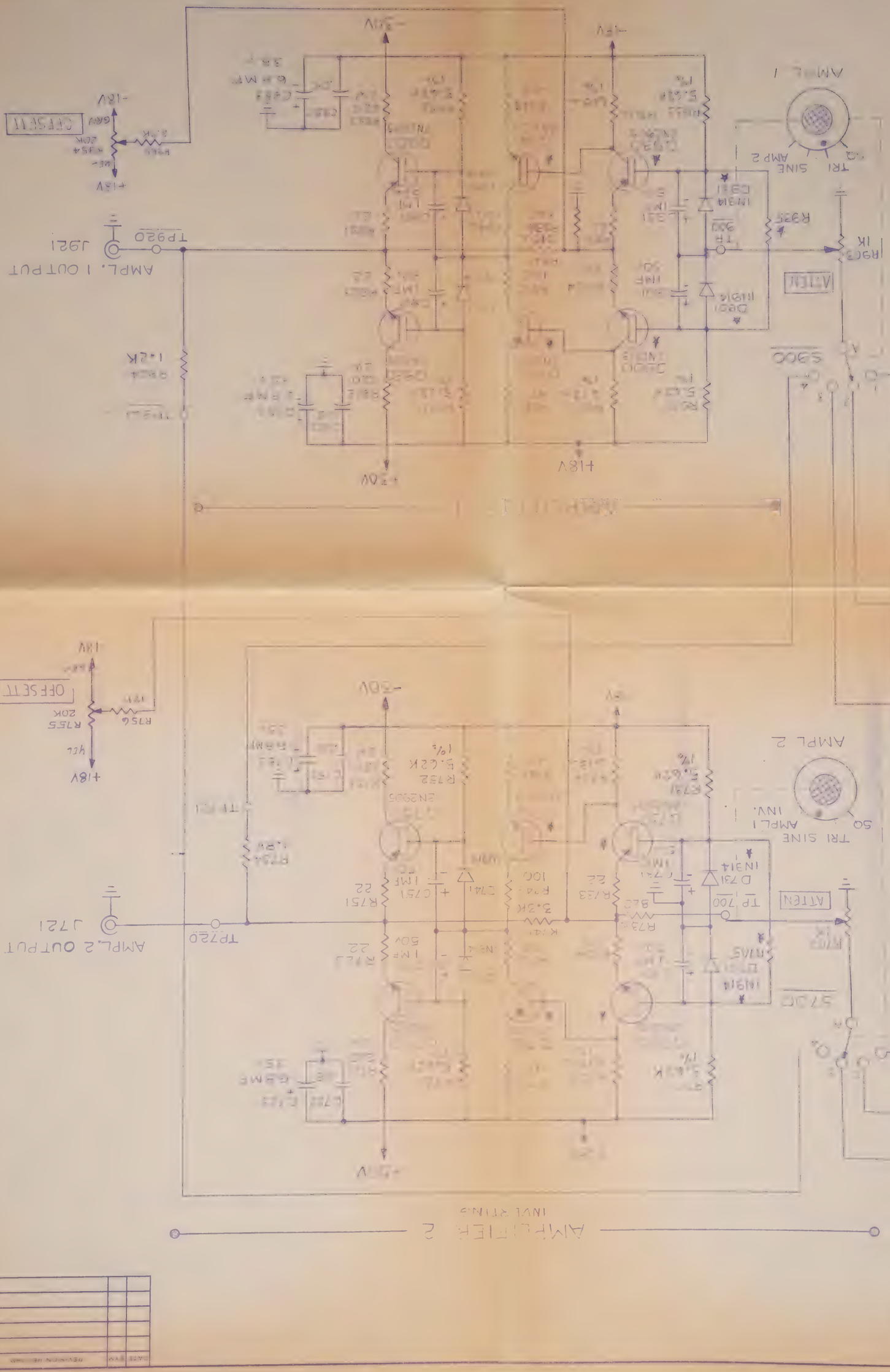
3) CAPACITOR VALUES MARKED IN MF UNLESS OTHERWISE NOTED

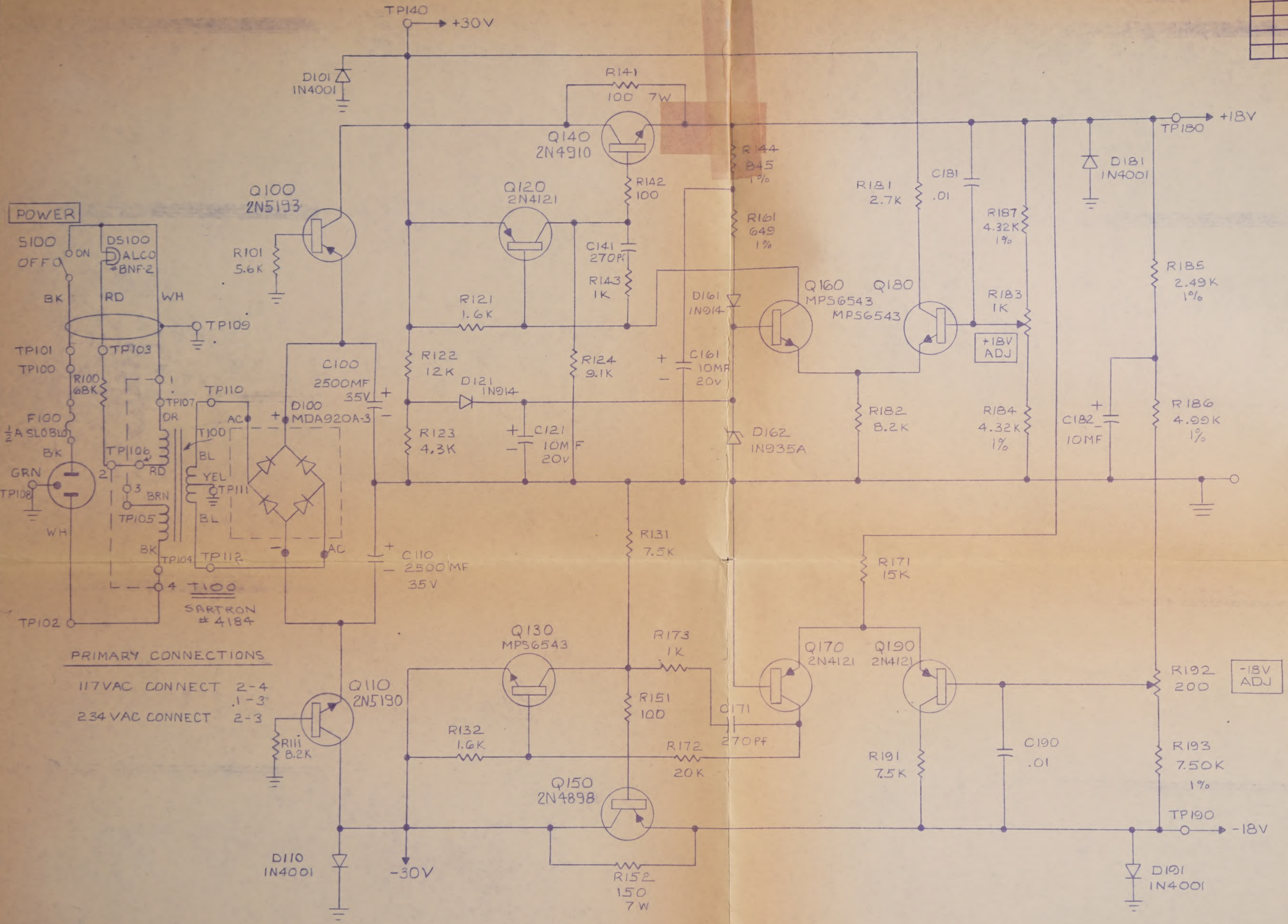
2) RESISTOR VALUES MARKED IN OHMS

1) E.B.C. MPS-U54 BOTTOM VIEW

SWITCH

TOLERANCES (EXCEPT AS NOTED)			
DECIMAL ±		SCALE	DRAWN BY
FRACTIONAL ±	TITLE SCHEMATIC - SINE SHAPER & AMPL. AMPL. 1, AMPL. 2		
ANGULAR ±	DATE 5/64	DRAWING NUMBER 505 -102	





PRIMARY CONNECTIONS

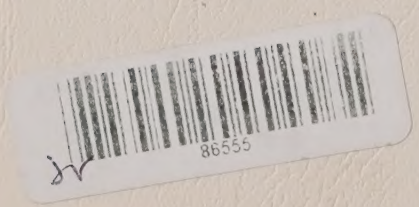
117VAC CONNECT 2-4
.1-3

234 VAC CONNECT 2-3

3) ALL CAPACITORS MARKED IN MF UNLESS OTHERWISE NOTED
2 ALL RESISTORS ARE 1/2W 5% UNLESS OTHERWISE NOTED
1 ALL RESISTORS MARKED IN OHMS
NOTES:

TOLERANCES (EXCEPT AS NOTED)			
DECIMAL ±		SCALE	DRAWN BY JE / APPROVED BY
FRACTIONAL ±	TITLE SCHEMATIC – POWER SUPPLY, MODEL 505		
ANGULAR ±	DATE 3-15-68	DRAWING NUMBER 505-103	

K+E ALBANENE ® 10 5465 ENGINEERS' STANDARD FORM
MADE IN U.S.A.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